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Procedia - Social and Behavioral Sciences 68 (2012) 649 – 660

Procedia Social and Behavioral Sciences

AicE-Bs 2012 Cairo
ASIA Pacific International Conference on Environment-Behaviour Studies
Mercure Le Sphinx Cairo Hotel, Giza, Egypt, 31 October – 2 November 2012
"Future Communities: Socio-Cultural & Environmental Challenges"

A Decision Making Approach for Prioritizing Local Communities' Development Investments

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Abstract

Integrated statistical-theoretical based approaches in decision support promise to support effective investment decision making. From this view, this paper proposes an innovative methodology to digitally indicate the true developmental level of villages (the smallest Egyptian local units), which would accordingly provide a precise guidance for fair investments' allocation according to their needs' priorities. This would be achieved through testing 158 variables; taking Farscour district in Damietta Governorate in Egypt as a case study. Accordingly, this paper comes out with a statistical methodology that enables decision makers map out the most deteriorated local communities and to set up investment priorities.

Keywords: Socio-cultural aspects; urbanization; local communities' needs; development challenges; investment priorities

1. Introduction

Decision-making is a very complex activity because of the interdependencies which exist between reasoning and making decisions (Johnson-Laird and Shafir, 1993). Moreover, most of the extensive research about the implementation and the use of information systems to support decision-making activities have pointed out their poor performance, the emphasis was on data collection and processing (Alter, 1980; Lucas, 1981; Meredith, 1981; Dickson and Wetherbe, 1985; Swanson, 1988). The persistent need of extracting real information from data to build the knowledge body of the decision model above-mentioned is a great concern for organizations to stop the continuing failure of both management and

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doi:10.1016/j.sbspro.2012.12.256

executive information systems (Moualek, 1997). Therefore, the main aim of this paper is to present a methodology that digitally indicates the most deteriorated local communities and the strongest ones to help allocate investments towards those who are in real need for them. It starts with a literature overview on previous digital methods explored for reaching the same aim of the paper. This is followed by presenting the variables used in this research to measure the developmental level, then ending with explaining the statistical analyses used and applied on the selected case study of Farscour district and its included 22 villages and two cities in Damietta Governorate in Egypt, together with highlighting the main findings of the research.

2. Overview on Decision Theories

When the feasible set of alternatives of a decision consists of a finite number of elements that are explicitly known in the beginning of the solution process, we have an important class of problems called multi criteria evaluation problems. Sometimes these problems are referred to as discrete multi criteria problems or selection problems. When the number of alternatives of a decision is uncountably infinite, the alternatives are not specified directly, but are defined in terms of decision variables as is usually done in single optimization problems like' linear programming. This type of problem is called a continuous decision problem in which the alternatives are only implicitly known. It is referred to as a multicriteria design problem or a continuous multicriteria problem. Here is a listing of many decision techniques found in the literature (Y. Aksoy, (1990), J.M. Booker and M.C. Bryson, (1985), P. Korhonen, et al (1992), M. Mollaghasemi and J. Pet-Edwards, (1997), W. Shin and A. Ravindran, (1991), D. White, (1990); Multicriteria evaluation methods, the outranking approach (Software Electre) by Roy (B. Roy, 1981) and Roy and Vincke (B. Roy and P. Vincke,1981), other methods developed by some French-Belgian school researchersare: Oreste by Roubens (M. Roubens, 1982) and Pastijn and Leysen (H. Pastijn and J. Leysen, 1989); Promethee by Brans, Mareschal and Vincke (1984); Multi attribute utility theory (Maut) by Keeney and Raiffa (1976); The analytic hierarchy process (Ahp) (software: Expert Choice) by Saaty (1980); the regime method by Hinloopen, Nijkamp and Rietveld (1983); the convex cone approach by Korhonen, Wallenius and Zionts (1984); the hierarchical interactive approach by Korhonen (1986); the visual reference direction approach (software: Vimda) by Korhonen (1988); the aspiration-level interactive method (Aim) by Lofti, Stewart and Zoints (1992); fuzzy set theory (L.A. Zadeh, 1965; H.J. Zimmermann, 1991); and Bayesian analysis (J.W. Newman, 1971); multicriteria design methods; goal programming (GP) and data envelopment analysis (DEA) of Charnes and Cooper (A. Charnes et al, 1961) and Charnes; Cooper and Rhodes (A. Charnes etal, 1978); the method of Geoffrion, Dyer and Feinberg (A. Geoffrion et al, 1972); the method of Zionts and Wallenius (S. Zionts et al, 1976); the reference point method of Wierzbicki (1980); the reference direction method of (Korhonen and Laakso, 1986); Paretorace of Korhonen and Wallenius (P. Korhonen et al, 1988); interactive weighted Tchebycheff procedure of Steuer and Choo (R. Steuer et al, 1983).

3. Proposal and Classification of Variables Used in the Statistical Analysis

It is worth mentioning that measuring the degree of development of any planning units is crucial to determine its requirements' priorities. Therefore, it is vital to define a set of variables for measuring this development. There exist many theories and proposals on how to measure the development. First, in the fifties the main indicators for measuring the development were economic especially the G.N.P per capita and the G.D.P per capita. Certainly, this was not enough to clarify the social and educational conditions nor their spatial distribution. Many attempts have appeared afterwards to include socio-economic indicators such as that of (Kamerschen D.,1968; Loher & powelson,1980; Meier G., 1989). In addition,

Soliman M.&Osman M.,1990 have tested Lorenz curve and Gini index on 26 Governorates in Egypt using other proposed development indicators. However, all these attempts are considered individual proposals. On the other hand, the human development report issued a number of indicators in 1990, 1994, and 2003. These have included about 158 indicators classified into 20 groups including human development index, profile of human development, profile of human deprivation, trends in human development, human capital formation, status of woman, female / male gaps, rural/ urban gaps, child survival & development, health profile, education flows, education imbalance, communication profile, labor force, unemployment, income distribution &poverty, urbanization, demographic profile, land resources, and finally participation in development.

Accordingly, based on the previous reviews, the variables used in this research were proposed and filtered according to the data available in the Central Agency for Public Mobilization and Statistics (CAPMAS) and local development information centre in Damietta governorate to 158 variables. These were classified into urban, economic, and social (demographic, educational, health care, cultural, and social services) variables and are shown in table (1). They were collected for the 22 villages and the two cities in Farscour district due to the continuous change in the administrative borders between cities and villages and would thus be all included within the coming statistical analyses.

Table 1. Development variables used in the statistical analysis

Urban variables	Social variables	Economic variables
Length of paved road	Social (Demographic variables)	No. of commercial buildings
Length of smoothed road	No. of population 1986	No. of industrial buildings(factories/workshops)
Length of unsmoothed road	No. of population 1996	Value of exported products
	Annual Growth rate	Value of local products
	Percentage from district population	Local income
	Average family size	No. of touristic rooms
	No. of families 1996	No. of touristic beds
	No. of population 2002	No. of annual touristic visitors
	No. of population 2007	No. of owners- females
	Estimated No. of population 2012	No. of owners- males
	Estimated No. of population 2017	No. of owners- males and females
	Estimated No. of population 2022	Cultivated land area- (feddan-thousands)
	Social (Educational services)	Cultivated land area- kirates
	No. of primary schools	Cultivated land area- sahm
	No. of Islamic Azhari primary schools	Crop composition (cultivated area-feddans)
	Total no. of primary schools	Crop composition (cultivated area-kirates)
	No. of preparatory schools	Crop composition (cultivated area-sahm)
	No. of Islamic Azhari preparatory schools	No. of chicken labs
	Total no. of preparatory schools	No. of eggs from chicken labs

No. of secondary schools
No. of Islamic Azhari secondary schools
Total no. of secondary schools
No. of technical secondary school
No. of classes (primary-preparatory-secondary)
No. of high institutes
No. of faculties
No. of female teachers (primary-preparatory-secondary)
No. of male teachers (primary-preparatory-secondary)
Total no. of teachers
No. of male students in first primary
No. of female students in first primary
Total no. of students in first primary
Total no. of male students in all stages
Total no. of female students in all stages
No. of enrolled students (primary-preparatory-secondary)
No. of enrolled students
No. of illiterates
No. of literacy target groups
No. of enrolled in literacy classes - females
No. of enrolled in literacy classes - males
No. of pass in literacy classes - females
No. of fail in literacy classes - males
No. of un-enrolled in literacy classes - females
No. of un-enrolled in literacy classes - males

Social (Healthcare services)

No. of children under 5 suffering from malnutrition
Death rate in children under 5
Death rate in children under 1

No. of produced honey cells
Average honey cells production
No. of livestock-milk
No. of livestock-meat- female
No. of livestock-meat- male
Total no. of livestock-meat
Coffee production- tons
Commercial electricity consumption(Kw/year)
No. of commercial members in electric network
No. of connected families in electric network
Residential electricity consumption(Kw/year)
Industrial electricity consumption(Kw/year)
No. of residential members connected to sewage system
No. of industrial members connected to sewage system
No. of houses connected to sewage pipes
Total no. of houses connected to sewage pipes or systems
Average water consumption
No. of families connected to water network
No. of residential units connected to water network
No. of members in water network
No. of residents connected to telephone network
No. of non-residents connected to telephone network
No. of residents connected to communication network
No. of non-residents connected to communication network
No. of post offices- agencies
No. of governmental post offices
No. of private post offices

Death rate in pregnant women	No. of computers-residents
No. of nurses for pregnant women	No. of computers-governmental
Monthly birth rate	
No. of enrolled in family planning methods-Bills	
No. of enrolled in family planning methods-loop	
No. of enrolled in family planning methods-other	
Total no. of enrolled in family planning methods	
No. of residents who benefits from free vaccination services-females	
No. of beds in hospitals	
No. of residents benefitting from maternity and childhood services	
No. of mothers taking vaccinations	
No. of residents going to clinics	
No. of residents benefitting from pregnancy services	
No. of pregnant women suffering from Anaemia	
No. of doctors	
No. of nurseries	
No. of nurses	
No. of medical helpers	
No. of permanent workers	
No, of labs' workers	
No. of employees in medical administrations	
No. of socialists	
No. of technicians in hospitals	
No. of temporary workers	
Total no. of workers and helpers in hospitals	
No. of health units	
Social (Entertainment services)	
No. of clubs	
No. of youth centres	
No. of playing courts	
No. of sports' centres	
No. of local gathering nodes	
Social (cultural services)	
No. of public libraries	
No. of cultural centres	
No. of children libraries	
No. of theatres	
No. of cinemas	
No. of distributed daily journals	

Social (social services)
No. of civil societies' organizations
No. of members in these-female
No. of members in these-male
No. of members in these-kids female
No. of members in these-kids male
No. of families benefiting from their services
No. of citizens benefiting from their services
No. of families benefiting from productive family project
No. of governmental social units
No. benefiting from exceptional pensions
No. benefiting from permanent pensions
Daily consumed flour(tons)
Daily consumed gas
No. of commercial markets
No. of basic food supply cards
No. of partial financed food supply cards
No. of totally financed food supply cards

4. Defining Steps for the Proposed Decision Making Process

Since all the above listed variables, which all contribute in defining the developmental level of any planning unit and in defining their requirements were so many and confusing, the statistical analysis was the best method selected to reach the most precise results using the SPSS (Statistical Package for Social Sciences) program by the factor analysis (the principal component method). It is one of the methods that are used for the exploration and the detection of patterning of variables with a view to the discovery of the new concepts, together with confirmatory uses for the testing of hypothesis about the structuring of variables in terms of the expected number of significant factors and factor scores. It classifies all the tested variables into components, each having a percentage for representing the strength of its correlated variables in affecting the results, called the total variance explained which validates the test when it is above 30 %. The component loadings on the other hand is an absolute number describing the strength of each variable inside these components and is considered effective when its absolute values is 0.5 or above. (Nie et al, 1975). Finally, the factor scores represent the strength of each of the case studies tested in this analysis (with numbers relative to each other). Four main analyses were undertaken according to the following steps. The following points explain these tests and their results briefly as all the resulting tables cannot be shown in the paper. The author has thus highlighted the main results as follows, with indication of all the factor scores in table (2) and an example of the component matrix results in table (3):

- In the first test, all the variables for the 22 villages and the two cities were tested. The first component has shown that the total variance explained reached 50% and this is a relatively high score. The factor scores revealed that the highest scores were occupied by the cities followed by sherbas, whereas the less developed villages is clearly the one with the lowest factor score, which is El Azazma. From the component matrix, the highest component loadings were for the social variables (educational services) followed by the economic and demographic variables, as shown in table (3).

- In the second test, another run was performed after excluding all the weak variables whose component loadings were less than 0.5 to ensure the accuracy of these results. The variables entered were 90 variables. The results have yielded the same findings explained in the first test.
- In the third test, all the variables were tested but without the two cities, to ensure that their data do not affect the rest of the results. The total variance explained here was 30.45%, and the highest factor score was for sherbas and the lowest one was for El Azazma. From the component matrix, the highest component loadings were for the social variables (educational services) followed by the economic and demographic variables.
- In the fourth test, only strong variables including 61 variables, whose component loadings were more than 0.5 were tested to ensure the accuracy of these results. The results have yielded the same findings explained in the third test.

Table 2. Results for the factor scores of the different statistical steps carried out

Planning Units' Names	Factor scores Step 1	Factor scores Step 2	Factor scores Step 3	Factor scores Step 4
Farscour city	4.09	4.19		
Al Roda city	1.75	1.62		
Sherbas	0.49	0.41	3.00	3.07
Al Rahmna	0.17	0.08	1.41	1.32
Abo Greida	-0.50	-0.45	-0.85	-0.73
El Azazma	-0.62	-0.56	-1.09	-1.05
El Obeidia	-0.33	-0.33	-0.36	-0.39
El Tarha	-0.56	-0.54	-0.84	-0.84
El Barashia	-0.38	-0.36	-0.32	-0.29
El Ghwabein	-0.28	-0.27	-0.04	0.01
Awlad Khalaf	-0.35	-0.36	-0.34	-0.25
El Ghoneimia	0.02	0.00	0.89	0.91
El Dhara	-0.32	-0.31	-0.33	-0.34
El Salemia	-0.61	-0.57	-1.26	-1.24
El Nagareen	-0.44	-0.43	-0.72	-0.72
Kafr El Arab	0.00	-0.05	1.02	0.84
Kafr El Shenawy	-0.50	0.47	-0.77	0.89
El Nasria	0.17	0.16	1.35	1.48
Karam wa Razook	-0.21	-0.17	-0.17	-0.17
El Arbein	-0.40	-0.38	-0.52	-0.55
El Hawarni	-0.24	0.26	0.09	0.06
Meit El Shoyokh	-0.45	0.45	-0.47	-0.44-
El Atwi	0.27	-0.27	0.13	0.10
Hagaga	-0.22	-0.26	0.18	0.10

Table 3. Resulting component matrix from the first test

	Urban variables		Social variables		Economic variables
			Social (Demographic variables)		
0.450	Length of paved road			0.596	No. of commercial buildings
-0.089	Length of smoothed road	0.968	No. of population 1986	0.911	No. of industrial buildings(factories/workshops)
0.713	Length of unsmoothed road	0.944	No. of population 1996	-0.076	Value of exported products
		-0.338	Annual Growth rate	-0.092	Value of local products
		-0.163	Percentage from district population	0.229	Local income
		-0.265	Average family size	0.179	No. of touristic rooms
		0.774	No. of families 1996	0.271	No. of touristic beds
		0.944	No. of population 2002	0.876	No. of annual touristic visitors
		0.944	No. of population 2007	0.005	No. of owners- females
		0.944	Estimated No. of population 2012	0.072	No. of owners- males
		0.944	Estimated No. of population 2017	0.576	No. of owners- males and females
		0.944	Estimated No. of population 2022	-0.075	Cultivated land area- (feddan-thousands)
			Social (Educational services)	0.138	Cultivated land area- kirates
		0.639	No. of primary schools	-0.033	Cultivated land area- sahm
		0.501	No. of Islamic Azhari primary schools	0.171	Crop composition (cultivated area-feddans)
		0.791	Total no. of primary schools	0.086	Crop composition (cultivated area-kirates)
		0.699	No. of preparatory schools	-0.050	Crop composition (cultivated area-sahm)
		0.825	No. of Islamic Azhari preparatory schools	0.576	No. of chicken labs
		0.835	Total no. of preparatory schools	-0.075	No. of eggs from chicken labs
		0.746	No. of secondary schools	0.138	No. of produced honey cells
		0.825	No. of Islamic Azhari secondary schools	-0.033	Average honey cells production
		0.882	Total no. of secondary schools	0.171	No. of livestock-milk
		0.838	No. of technical secondary school	0.086	No. of livestock-meat- female
		0.986	No. of classes (primary-preparatory-secondary)	-0.050	No. of livestock-meat- male
		0.988	No. of high institutes	0.430	Total no. of livestock-meat
		0.979	No. of faculties	-0.109	Coffee production- tons
		0.993	No. of female teachers (primary-preparatory-secondary)	0.606	Commercial electricity consumption(Kw/year)
		0.911	No. of male teachers (primary-preparatory-secondary)	0.589	No. of commercial members in electric network
		0.912	Total no. of teachers	0.212	No. of connected families in electric network
		0.911	No. of male students in first primary	0.451	Residential electricity consumption(Kw/year)
		0.912	No. of female students in first primary	0.980	Industrial electricity consumption(Kw/year)
		0.913	Total no. of students in first primary	0.565	No. of residential members connected to sewage system
		0.992	Total no. of male students in all stages	0.817	No. of industrial members connected to sewage system
		0.990	Total no. of female students in all stages	0.512	No. of houses connected to sewage pipes
		0.992	No. of enrolled students (primary-preparatory-secondary)		Total no. of houses connected to sewage pipes or systems
		0.992	No. of enrolled students	0.971	Average water consumption

0.965	No. of illiterates	0.973	No. of families connected to water network
-0.060	No. of literacy target groups	0.735	No. of residential units connected to water network
-0.025	No. of enrolled in literacy classes - females	0.843	No. of members in water network
0.146	No. of enrolled in literacy classes - males	0.535	No. of residents connected to telephone network
0.078	No. of pass in literacy classes - females	0.713	No. of non-residents connected to telephone network
-0.237	No. of fail in literacy classes - males	0.935	No. of residents connected to communication network
-0.059	No. of un-enrolled in literacy classes - females	0.813	No. of non-residents connected to communication network
0.075	No. of un-enrolled in literacy classes - males	0.871	No. of post offices- agencies
	Social (Healthcare services)	0.500	No. of governmental post offices
-0.012	No. of children under 5 suffering from malnutrition	0.373	No. of private post offices
0.694	Death rate in children under 5	0.895	No. of computers-residents
0.819	Death rate in children under 1	0.867	No. of computers-governmental
0.726	Death rate in pregnant women		
0.047	No. of nurses for pregnant women		
0.874	Monthly birth rate		
0.847	No. of enrolled in family planning methods-Bills		
0.910	No. of enrolled in family planning methods-loop		
0.859	No. of enrolled in family planning methods-other		
0.904	Total no. of enrolled in family planning methods		
0.460	No. of residents who benefits from free vaccination services-females		
0.947	No. of beds in hospitals		
0.886	No. of residents benefitting from maternity and childhood services		
0.867	No. of mothers taking vaccinations		
0.021	No. of residents going to clinics		
0.708	No. of residents benefitting from pregnancy services		
0.885	No. of pregnant women suffering from Anaemia		
0.029	No. of doctors		
0.137	No. of nurseries		
0.938	No. of nurses		
0.871	No. of medical helpers		
0.332	No. of permanent workers		
0.941	No, of labs' workers		
0.886	No. of employees in medical administrations		
0.269	No. of socialists		
0.793	No. of technicians in hospitals		
-0.068	No. of temporary workers		
0.863	Total no. of workers and helpers in hospitals		
0.882	No. of health units		
	Social (Entertainment services)		

0.871	No. of clubs
0.092	No. of youth centres
0.387	No. of playing courts
0.310	No. of sports' centres
0.312	No. of local gathering nodes
	Social (cultural services)
0.814	No. of public libraries
0.899	No. of cultural centres
0.104	No. of children libraries
0.961	No. of theatres
0.886	No. of cinemas
-0.022	No. of distributed daily journals
	Social (social services)
0.397	No. of civil societies' organizations
0.694	No. of members in these-female
0.899	No. of members in these-male
0.863	No. of members in these-kids female
0.911	No. of members in these-kids male
0.353	No. of families benefiting from their services
0.408	No. of citizens benefiting from their services
-0.159	No. of families benefiting from productive family project
0.632	No. of governmental social units
-0.176	No. benefiting from exceptional pensions
0.930	No. benefiting from permanent pensions
0.963	Daily consumed flour(tons)
0.943	Daily consumed gas
0.574	No. of commercial markets
0.971	No. of basic food supply cards
0.724	No. of partial financed food supply cards
0.723	No. of totally financed food supply cards

It is clear from the previous statistical analyses that the two main cities in Farscour district are dominant and represent a separate developmental entity isolated from the rest of the villages existing within its administrative border, and which are very deteriorated. This represents a clear proof for the extreme centralization that Farscour and Al Rowda cities have full control of. This was obviously clear from the results of the four tests which yielded the same findings with or without the cities, as most of the factor scores of the villages were negative, and have slightly increased after excluding the cities and the weak variables.

These results represent important findings for decision makers as they can precisely guide them through setting the priorities and allocating the investments to the villages and the local communities that are in real need for development, and for reaching justice in services and economic activities distribution.

5. Conclusion

Multi-sectoral systems, such as cities and local communities' entities (villages), face strategic challenges of optimal development due to the complexity of interacting perspectives, interests, and

preferences of decision-makers and stakeholders. From this view, this paper has presented an integrated statistical-theoretical based approache in decision support to generate efficient and effective results and to guarantee fair investment allocation plans. These types of analyses are one of the tools that policy makers can use to support effective investment decision making in prioritizing the local communities' development strategies. Accordingly, this innovative methodology has presented a digital indication for the true developmental and deterioration level of villages (the smallest Egyptian local units), which would accordingly provide a precise guidance for fair investments' allocation according to their needs' priorities. This has been achieved through testing 158 variables classified into urban, social and economic variables by the factor analysis (principal component) using the SPSS program on all the smallest planning units' levels in Egypt; compromised within the district. Therefore, these tests were applied on the local units and cities comprising Farscour district in Damietta Governorate to end up with a precise numerical value for each planning unit describing its developmental level as compared to each other.

Accordingly, this paper has come out with a statistical methodology that enables policy and decision makers map out the most deteriorated local communities and to set up the development and investment priorities. Moreover, the results of this study have clarified that the social variables especially those related to the educational services have proven to be the most important variables causing change in data and thus have turned out to be the most effective in enhancing the developmental level, followed by the economic variables then the urban variables in accordance with the study classification.

Acknowledgements

I would like to thank Dr. Tarek Abdel Latif Aboul Atta, for giving be the opportunity to work in this research as part of a project undergone by his Planning Consultancy Office, and for his supervision and valuable comments throughout all the procedures of this work.

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